OPERATING INSTRUCTIONS

TYPE 1550-A

OCTAVE-BAND NOISE ANALYZER

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GENERAL RADIO COMPANY

749-F

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TYPE 1550-A

OCTAVE-BAND NOISE ANALYZER

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GENERAL RADIO COMPANY
WEST CONCORD, MASSACHUSETTS, USA

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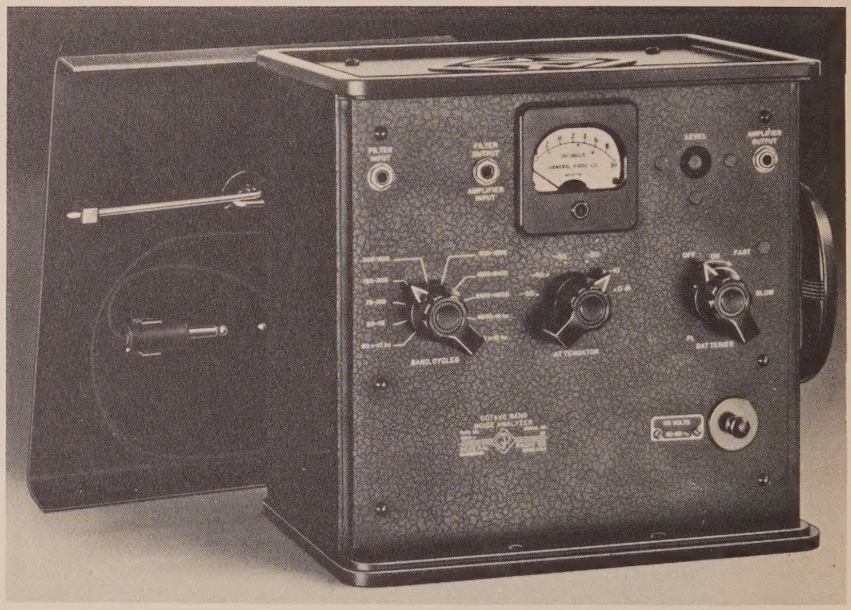

Panel View of the Type 1550-A Octave-Band Noise Analyzer.

SPECIFICATIONS

Range: 20 cycles to 10,000 cycles in 8 bands,

20 c to 75 c (low pass)	600 c to 1200 c
75 c to 150 c	1200 c to 2400 c
150 c to 300 c	2400 c to 4800 c
300 c to 600 c	4800 c to 10,000 (high pass)

In addition, a band with a flat characteristic from 20 c to 10 kc is available at two switch positions for convenience in calibration against the sound-level meter.

Input Level: Between 1 and 10 volts for normal range. Levels below one volt reduce the range of reading; those higher than 10 volts overload the filters.

Input Impedance: 20,000 ohms. Input is isolated by a resistance pad, so that performance is independent of source if source impedance is constant over audio range or is small compared to 20,000 ohms.

Source: Sound-level meter supplying analyzer input must have low hum, low internal noise, and low distortion. The TYPE 1551-B Sound-Level Meter is recommended.

Direct Use with Microphone: The TYPE 1551-P1L and -P1H Condenser Microphone Systems or the TYPE 759-P25 Dynamic Microphone Assembly can be used if the band levels exceed 70 db, 85 db, and 70 db, respectively (re 0.0002 μbar). A TYPE 1550-P1 Microphone Adaptor Plug is required with the TYPE 759-P25 Dynamic Microphone Assembly.

Level Indication: Level is sum of meter and attenuator readings.

Attenuation: Except for the lowest and highest bands, at least 30-db attenuation is obtained at one-half the lower nominal cut-off frequency and twice the upper nominal cut-off frequency; at least 50-db attenuation is obtained at one-fourth the lower nominal cut-off frequency and at four times the upper nominal cut-off frequency. The 75-cycle low-pass filter has at least 30-db attenuation at 200 c and 50 db at 400 cycles. The 4800-cycle high-pass filter has at least 30-db attenuation at 2400 cycles and 50 db at 1200 cycles.

Accessories Supplied: Dial and dial clamp; shielded cable for connecting analyzer to sound-level meter.

Tube Complement: Three 1U4 and one 1T4.

Power Supply: Battery, Burgess 6TA60. Battery is included in price. For ac operation, TYPE 1261-A Power Supply fits battery compartment.

Dimensions: (Width) $11\frac{3}{8}$ × (height) $12\frac{9}{16}$ × (depth) 9 inches, over-all.

Net Weight: 27 pounds including battery.

Type 1550-A Octave-Band Noise Analyzer

The Type 1550-A Octave-Band Noise Analyzer is intended primarily for use with the Types 1551 and 759-B Sound-Level Meters to separate complex sounds and noises into bands of energy an octave wide in frequency. It is also useful as a general-purpose analyzer, as a filter unit, and as a selective detector. It meets the requirements of the American Standards Association Specification Z24.10 - 1953.

Section 1.0 Description

The Type 1550-A Octave-Band Noise Analyzer consists of a filter set, a calibrated attenuator, an amplifier, an output voltmeter, and a monitoring output, as shown in the simplified schematic of Figure 4. A complete circuit diagram is shown in Figure 3.

The filter set consists of networks of capacitors, inductors, and resistors that are switched to produce eight pass bands. The pass bands have the following nominal cut-off frequencies:

20 c - 75 c (low pass)	600 c - 1200 c
75 c - 150 c	1200 c - 2400 c
150 c - 300 c	2400 c - 4800 c
300 c - 600 c	4800 c - 10 kc (high pass)

Two switch positions where the filter networks are left out of the circuit are also provided. A representative set of selectivity curves is shown in Figure 1.

The attenuator is a simple resistance pad that gives up to 50 db attenuation in 10 db steps. Thus measurements can be made with band levels extending over a range of more than 50 db.

The amplifier is an audio amplifier with a potentiometer gain control. It drives an output meter of the same characteristics as the meter used on the Types 1551 and 759-B Sound-Level Meters. This meter has a calibrated range from −6 to +10 db to cover the intervals between the steps of the attenuator.

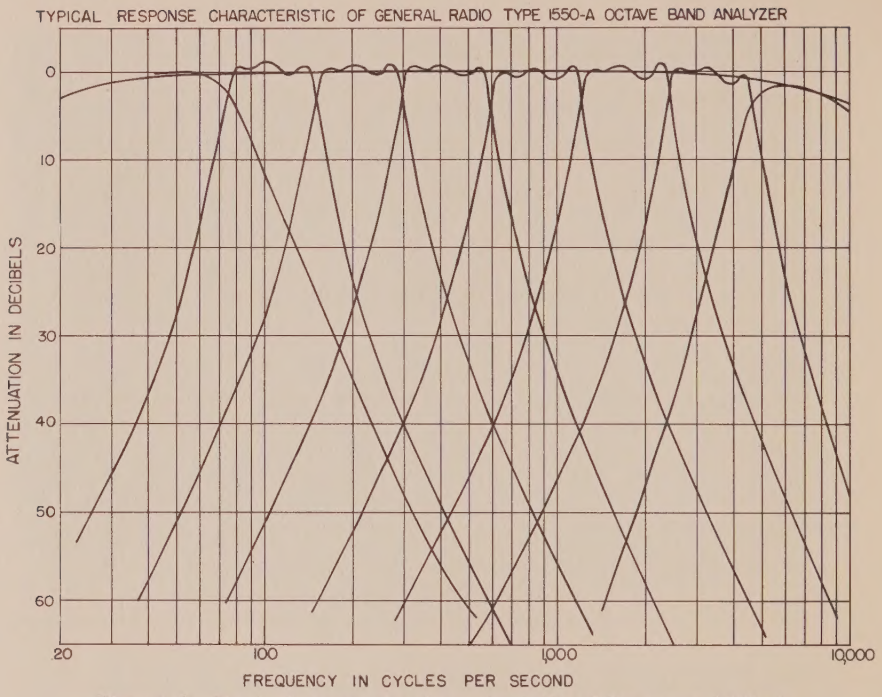

Figure 1. Typical response characteristic of the Type 1550-A Octave-Band Noise Analyzer.

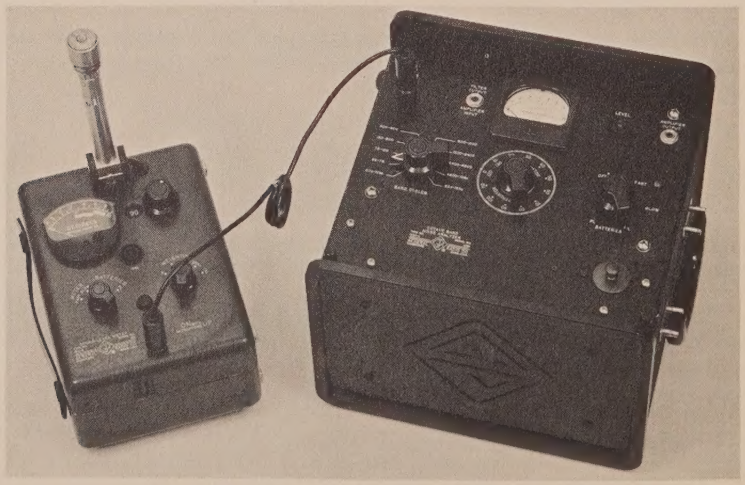

Figure 1a. Type 1550-A Octave-Band Noise Analyzer and Type 1551-B Sound-Level Meter interconnected for analysis for airborne sound.

Section 2.0 Operation

2.1 BATTERIES OR TYPE 1261-A POWER SUPPLY

Place a Burgess Type 6TA60 battery, or equivalent, or a Type 1261-A Power Supply in the mounting provided. (The Type 1261-A Power Supply should have a P4 plug.) Plug in the battery plug provided at the end of the cable.

The power switch also checks the battery voltages. Replace the batteries when the deflection is below the red line at B. Before checking batteries, turn the attenuator to 0 db and the LEVEL control sufficiently far down so that there is no deflection on the meter from an applied signal.

2.2 TUBES

The following tubes are used: V-51, V-52, and V-54: Type 1U4; V-53: Type 1T4. For their location, see Figure 5. The tubes are readily accessible if the battery is removed from its mounting.

2.3 TUNING

The analyzer is tuned by means of the BAND switch. The two bands marked 20c - 10kc are used to provide a measure of the over-all level. The only selectivity provided in these positions is the broad response inherent in the amplifier. The other eight marked switch positions select the appropriate filter units for the designated nominal cut-off frequencies.

2.4 SOUND ANALYSIS - RELATIVE READINGS

To analyze a sound, connect the input of the analyzer to the output of the Type 1551 or Type 759-B Sound-Level Meter by means of the cord provided. (See Figure 1a.) Use the C-weighting network on the sound-level meter. The level of the sound which strikes the microphone will be indicated directly on the meter on the panel of the sound-level meter. This reading is the total sound pressure. Set the BAND switch to one of the 20-c - 10-kc positions. Set the ATTENUATOR switch to 0 db and adjust the thumb-operated LEVEL control so that the indicating meter on the analyzer reads 0 db. Then the LEVEL control should be left in this position for the analysis. (When a different sound is to be analyzed, a new setting of the LEVEL control must be determined.) The corresponding band levels are then obtained by switching to the appropriate band and noting the meter and attenuator readings. These readings are then relative to the over-all level. They can be converted to absolute levels by adding the relative level algebraically to the reading of the sound-level meter. A more accurate technique for absolute levels is outlined in Paragraph 2.5. Note: Graph paper suitable for plotting the observed levels in octave bands is available from the Codex Book Company, Inc., Norwood, Massachusetts, as No. 31,460, Sound Analysis by Octave Bands.

2.5 INSTALLATION AND USE OF MOVABLE ATTENUATOR DIAL PLATE

2.5.1 GENERAL. The Movable Attenuator Dial Plate on the Type 1550-A Octave-Band Noise Analyzer adapts the instrument to read over-all and octave-band pressure levels directly.

The Movable Attenuator Dial Plate consists of a Type 1550-94 Plate and a Type 1550-67 Clamp. The plate is a flat aluminum disk, 2-3/4 inches in diameter, with a center hole about 1-1/8 inches in diameter. Lines are etched radially around the circumference of the plate for the sole purpose of providing a grip for rotating the dial. These lines and number markings from 0 to 130 in increments of 10 are white on black.

The clamp is a flanged disk, which mounts on the Analyzer panel, and which holds the plate in place.

2.5.2 INSTALLATION.

a. Turn the ATTENUATOR knob fully clockwise, loosen its two set screws, and remove it from the shaft.

b. Remove the two knob stop screws and lock washers from the panel.

c. Bend the dial plate slightly along its diameter to provide friction against the panel.

d. Insert the dial clamp in the plate, with the side with the greater diameter on the engraved side of the plate.

e. Secure the assembly to the panel with the two knob stop screws and lock washers.

f. Test for proper friction. The dial should turn readily, but should have enough friction to resist accidental disturbances. Removing the dial plate and bending it more or straightening it out will increase or decrease friction, if necessary. A small amount of light grease on the back of the dial will reduce wear on the panel.

g. Replace the knob on the shaft, turn it fully clockwise (against the stop screw), and tighten the two set screws.

NOTE

Because of the rotation stops on both the ATTENUATOR switch and the knob, it is essential that the knob be replaced in the same position as before removal.

2.5.3 USE WITH MICROPHONE DIRECTLY AT HIGH (ABOVE 70 DB) LEVELS. If the band levels of the signals to be tested exceed approximately 70 db (re 0.0002μbar), the Octave-Band Noise Analyzer can be used directly with a microphone*, with a reference pressure established at the microphone by means of the Type 1552-B Sound-Level Calibrator. The procedure is as follows.

a. Turn the ATTENUATOR knob fully clockwise and rotate the dial plate until 130 falls under the knob pointer.

b. Turn the ATTENUATOR knob and adjust the LEVEL control until the total of the ATTENUATOR setting and the meter indication equals the reference pressure output of the Calibrator. For example, if the output into the microphone is 116 db, the ATTENUATOR knob should be turned to 110,

* Type 1551-P1L Condenser Microphone System or Type 759-P25 Dynamic Microphone Assembly.

and the LEVEL control adjusted so that the meter reads 6 db. The Octave-Band Noise Analyzer is then direct reading in over-all (20c-10kc) and octave-band pressure levels from 74 to 140 db.

If it is desired to measure weaker sounds, and if there is adequate sensitivity, follow the procedure outlined in steps a and b, except initially set the dial plate so that 120 falls under the knob pointer when the knob is turned fully clockwise. The Analyzer will then be direct reading from 64 to 130 db.

2.5.4 USE WITH SOUND-LEVEL METER. If the band levels of the signals to be tested fall below approximately 70 db (re 0.0002μbar), the Type 1551 or other sound-level meter should be used ahead of the Octave-Band Noise Analyzer. The sound-level meter should first be calibrated, either by its own calibration system or by the Type 1552-B Sound-Level Calibrator. (Refer to applicable instruction manuals.) Then the Octave-Band Noise Analyzer can be calibrated, by either signal source. Then, using either the internal calibration, the 60-cycle system, or the Calibrator, proceed as follows:

a. Set the BAND: CYCLES switch in the Analyzer to 20c-10kc, and turn the ATTENUATOR knob fully clockwise.

b. Adjust the LEVEL control until the meter indications are the same on the Sound-Level Meter and the Analyzer.

c. Remove the test signal, and turn the DECIBEL switch on the Sound-Level Meter until the meter gives a positive indication from the sound to be analyzed.

d. Rotate the movable dial plate until the ATTENUATOR knob points to the number indicated by the DECIBEL switch on the Sound-Level Meter. The Octave-Band Noise Analyzer is then direct reading in over-all and octave-band pressure levels as long as the DECIBEL setting in the Sound-Level Meter is not changed.

If it is certain that there are no very high or very low frequency components in the signal to be tested, the Analyzer can simply be set to match (at 20c-10kc) the Sound-Level Meter indication for any arbitrary noise. It should be remembered that there is a fall-off in the frequency response of the Analyzer at the high and low ends of the band, and there may be an error of several decibels in the calibration if there are strong very high or very low frequency components in the noise under test. For example, the noise from ventilating systems may have strong components below 20 cps.

If the noise being analyzed has a marked variation in level with frequency, the inherent noise from the sound-level meter* supplying the signal may limit the analysis. For example, the noise level from the Type 1551-A

*This situation has been improved by a factor of 20db or more in the Type 1551-B Sound-Level Meter, so that it is rarely a limiting factor.

Sound-Level Meter is about 42 db below full scale (+10) on the meter, as measured in the band from 4800c to 10kc. Thus, if the noise to be measured had an actual level in this band of, say, 50 db below the over-all level at full scale, the level as read would actually be about 41 db below the over-all level. In this example the level as read would be determined almost entirely by the sound-level meter.

This situation can usually be improved by using the A-weighting network of the sound-level meter for analysis in the bands above 600 cps. The procedure is as follows: A complete analysis is made by using the C-weighting network. If any of the levels in the four upper bands is 30 db or more below the over-all level, the sound-level meter is switched to the A-weighting network. The sound-level meter DECIBELS control is reset to bring the reading of its meter in the range above 0 db. Then additional readings are taken in the four upper bands of the octave-band analyzer, as described in step d above. The level in the band from 4800c to 10 kc should usually be increased by about 2 db to correct for the difference in frequency response of the A- and C-weighting networks. These new levels for the four upper bands should be compared with those obtained with the C-weighting network. In each band, the lower of the two readings is then generally the one that is more likely correct.

2.6 CORRECTIONS FOR FREQUENCY- RESPONSE CHARACTERISTIC

The frequency-response characteristic, shown in Figure 1, can be used to correct the measured level in a band for the departure from uniformity of response. The only important correction is the one for the band from 4800c to 10 kc, where about 2 db should be added to the observed level. This correction will bring its average response up to the average of the other bands. Naturally, a more accurate correction can be made by the use of the measured response characteristic of the particular filter used for the analysis of the noise.

2.7 SPECTRUM LEVEL

The spectrum level at a particular frequency is the r-m-s sound pressure level, or r-m-s voltage level, for the energy contained within a band one cycle per second wide centered on that frequency.[1] This level or an equivalent spectrum level can be computed from the octave-band levels by subtracting the numbers in the second column of Table I from the octave-band levels. Because of the frequency characteristic of the microphone, these values must be modified when using the sound-level meter. Representative values for the Shure Brothers Type 98B99 microphone used on the Type 1551 are shown in the third column. These values have been determined on the assumption of a broad-band, flat-frequency, random noise. For other noise with spectrum levels that vary rapidly with frequency or that include discrete frequency components, the figure so determined has significance only as an equivalent spectrum level. These values are frequently plotted at the geometric mean frequency of the band shown in column four of Table I.

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[1] ASA, Z24.1-1951 American Standard Acoustical Terminology.

TABLE I

BAND	Decibels to be subtracted from the octave-band levels to obtain spectrum levels		Geometric Mean Frequency (Cycles)
	1550-A alone	1550-A + 1551	
20 c - 75 c	18	17	39
75 c - 150 c	19	19	106
150 c - 300 c	22	22	212
300 c - 600 c	25	25	425
600 c - 1200 c	28	28	850
1200 c - 2400 c	31	31	1700
2400 c - 4800 c	34	34	3400
4800 c - 10 kc	38	35	6900 or 6200

2.8 USE WITH A RECORDER

The output system will supply approximately 0.5 volt across a 10,000-ohm load when the meter is at full scale. This output is adequate for most applications with the Type 1521-A Graphic Level Recorder. When the level recorder is used to cover a range of levels of as much as 40 db without changing the ATTENUATOR setting, it is desirable to set the ATTENUATOR of the Type 1550-A at the extreme counterclockwise position or to the position just left of straight up, and to adjust the LEVEL control to keep the meter reading on scale in the over-all (20 cycles to 10 kilocycles) position. This setting gives a better signal-to-noise ratio for recording than setting the ATTENUATOR to the extreme clockwise position.

2.9 CHOICE OF WEIGHTING NETWORK ON SOUND-LEVEL METER

For sound or noise analysis, the C curve (flat) generally should be used. This gives a direct physical measurement of the level in each band. However, refer to Paragraph 2.5.4 for special conditions that require the use of the A-weighting network.

2.10 INPUT AND OUTPUT IMPEDANCES

The input impedance of the analyzer is approximately 20,000 ohms resistive. The filter characteristic is essentially independent of the source used to supply the analyzer, provided the source impedance is constant over the audio-frequency range or small compared to 20,000 ohms.

The AMPLIFIER OUTPUT jack will supply approximately one volt across a 20,000-ohm load when the indicating meter is at full scale. Any impedance may be plugged into the AMPLIFIER OUTPUT jack without appreciably affecting the analyzer readings.

2.11 ELECTRICAL WAVE ANALYSIS

Within its amplitude and frequency limits, the Type 1550-A Octave-Band Noise Analyzer can be used for analyzing any electrical signal for the energy in the eight bands. Measurement procedure is the same as outlined

above, except that the audio-frequency source to be measured is substituted for the sound-level meter or microphone.

2.12 CAUTION

Some sound-level meters, such as the old Type 759-A Sound-Level Meter, do not provide a low-distortion output for analysis. The distortion introduced by such a preamplifier will result in errors in analysis by introducing components that are not present in the original signal. The Type 1551 and the Type 759-B Sound-Level Meters, when properly used, operate with sufficiently low distortion so that the errors caused by distortion are generally negligible. The Type 759-A can be improved in this respect by using a two-circuit jack in the output. This jack should be connected to open the meter circuit when a plug is put in.

Any noise or hum introduced, in addition to the desired signal, by the microphone and amplifier can also lead to incorrect results in analysis. Usually an analysis of the residual signal with the microphone disconnected or, preferably, replaced with an equivalent source impedance, will show up the extent of these effects. When the measurement is to be made at low levels, a 1500 to 2000 $\mu\mu$f capacitor, which simulates the equivalent capacitance of the microphone, must be connected from terminal 3 to 1 or 2 in order to get equivalent results. This capacitor and the plug must be shielded to avoid electrostatic pickup.

It is good practice to check that the sum of the individual band levels is equal, within 1 or 2 db, to the over-all level. If this result is not obtained, an error exists, either in the summing or the measurement procedure, because of faulty or incorrectly used equipment, or because the noise is of an impact type. Impact-type noises sometimes give over-all levels appreciably less than the sum of the levels in the individual bands, even when the "FAST" position of the meter switch is used. This result is obtained because of the inability of the meter to indicate the instantaneous levels occurring in very short intervals. The levels at low frequencies tend to be nearer the peak value in those bands, while the over-all and high-frequency bands are significantly less than the peak value. When this type of discrepancy is observed, a Type 1556-A Impact Noise Analyzer should be used, or an oscillographic measurement is desirable.

2.13 BACKGROUND NOISE

When the spectrum of the acoustic noise from a machine is measured, other sources of sound may contribute to the level determined by the analyzer. Whenever possible, this background noise should be measured by the analyzer to determine whether or not the desired measurement is noticeably affected by the background. If analysis is made with the machine under test

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* When microphonics are serious, the levels in all the bands appear to be nearly alike so that the sum may be as much as 9 db higher than the over-all level. See paragraph 2.15. If the output from the sound-level meter is plugged, mistakenly, into the FILTER OUTPUT AMPLIFIER INPUT jack, a similar incorrect result is obtained.

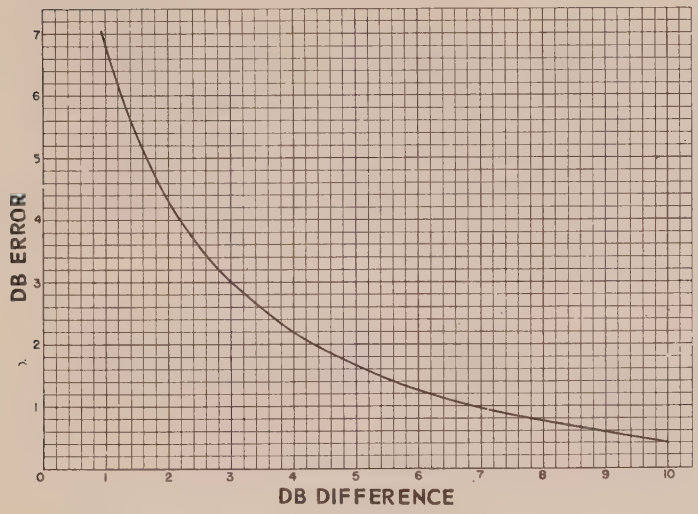


Figure 2. Error in sound measurements introduced by background noise. The horizontal scale is the difference in readings, for any particular band, with and without the machine under test in operation. The vertical scale gives the number of decibels to be subtracted from the higher reading to give the correct value for machine noise.

operating and another with the machine not operating, the graph of Figure 2 can be used to determine the importance of the background noise. When the background noise is analyzed, the setting of the sound-level meter DECIBELS control should usually be the same as the setting when the total noise was measured.

2.14 MAXIMUM AND MINIMUM INPUT VOLTAGES

Under most conditions, the maximum input voltage that should be used is 10 volts. Voltages higher than 10 volts will cause an appreciable change in the filter characteristics of the low-frequency filters if most of the signal energy is at low frequencies; but no damage will result if voltages are kept below 100 volts peak. If the ATTENUATOR is to be left set at the extreme counterclockwise position for recording purposes, the input signal should not exceed 2 volts in order to avoid errors from grid current in the first stage.

The maximum sensitivity of the amplifier depends on the condition of the tubes and batteries. When tubes and battery voltages are normal, the minimum detectable signal is about 0.3 millivolt. Therefore, in order to cover a range of 50 db in analysis, at least 0.1 volt over-all must be available at the input terminals.

2.15 MICROPHONICS

All vacuum tubes are affected by mechanical vibration. At sufficiently high sound levels, the tubes in the amplifier section of the analyzer can be vibrated to such an extent that they contribute an undesired signal to the output. Trouble from this effect, which is called microphonics, is not usually experienced until the sound levels are above 100 db, unless the instruments are placed on supports that carry vibrations directly to the instruments. The usual test for microphonics is to disconnect the input cord to see if the indicated level comes from the input signal or if it is generated within the analyzer. The analyzer can also be lifted up from the support on which it is placed to see whether or not the vibrations are transmitted through the supports or if it is the air-borne sound that is causing the tube vibration.

If trouble from microphonics is experienced, there are several ways of relieving the difficulty. One procedure that should be tried is the following: When the initial level is set up according to the method of paragraph 2.5, set the ATTENUATOR one step to the left of the extreme clockwise position. Adjust the LEVEL control as before.

Further possible remedies for microphonic troubles are as follows: (1) Place the analyzer on a soft rubber pad. (2) Remove the analyzer from the intense sound field to another room and interconnect to microphone with a long cable. (3) Put in deadened sound barriers between the instrument and the sound source. (4) Mount the instrument in a well sealed box with a glass cover and tight-fitting drive shafts to manipulate the controls.

2.16 LOUDNESS

A calculation of the approximate loudness of a noise can be made from the results of an octave-band analysis by the method given in the "Handbook of Noise Measurement," published by General Radio Company.

2.17 SPEECH-INTERFERENCE LEVEL

The simple average of the absolute octave-band levels in decibels for the 600 - 1200, 1200 - 2400, and 2400 - 4800 bands has been called the speech-interference level.[2] It has been found particularly useful for rating noise in airplane cabins, where the ability of passengers to converse at various voice levels and distances can be determined approximately in terms of speech-interference level, as shown in Table II.

2.18 USE OF AMPLIFIER OR FILTER ALONE

The jack labeled FILTER OUTPUT/AMPLIFIER INPUT is provided in case the amplifier or filter is to be used alone. When the amplifier is used alone, the BAND switch should be put in one of the two unmarked positions,

[2] Leo L. Beranek and H. Wayne Rudnose, "Sound Control in Airplanes", Journal Acoustical Society of America, Vol. 19, No. 2, March, 1947, pp 357-364.

and the input signal should be fed into the AMPLIFIER INPUT jack. A voltage gain of at least 70 db is then obtainable from INPUT to OUTPUT.

When the filter is used alone, the OFF-ON switch should be left in the OFF position. The filter should work into a high impedance of the order of only 100 $\mu\mu$f with a shunting resistance of 0.5 megohm or more in order to preserve the characteristics of the filter. In other words, the terminations for the filter are provided in the unit itself, and the external load connected to the FILTER OUTPUT should generally be a vacuum-tube amplifier of high input impedance.

TABLE II

Maximum Values of Speech-Interference Levels of Noise for which Satisfactory Speech Intelligibility will be Obtained for Average Voices and Hearing.

Distance (inches)	Voice Level		
	Loud	Extra Loud	Shouting
6	77	83	89
12	71	77	83
24	65	71	77
36	61	67	73
48	59	65	71
60	57	63	69
72	55	61	67

This speech-interference level has also been used to rate office noise.[3]

[3]Leo L. Beranek and R. B. Newman, "Speech-Interference Levels as Criteria for Rating Background Noise in Offices", presented at June 22, 1950, Meeting of Acoustical Society of America, State College, Pennsylvania.

Section 3.0 Maintenance

3.1 GENERAL. The two-year warranty given with every General Radio instrument attests the quality of materials and workmanship in our products. When difficulties do occur, our service engineers will assist in any way possible.

In case of difficulties that cannot be eliminated by the use of these service instructions, please write or phone our Service Department, giving full information of the trouble and of steps taken to remedy it. Be sure to mention the serial and type numbers of the instrument.

Before returning an instrument to General Radio for service, please write to our Service Department or nearest district office (see back cover), requesting a Returned Material Tag. Use of this tag will insure proper handling and identification. For instruments not covered by the warranty, a purchase order should be forwarded to avoid unnecessary delay.

3.2 TROUBLE SHOOTING. If the analyzer becomes inoperative, first check battery voltages. No reading of plate and filament voltages may mean the battery plug is not making proper contact or the a-c supply may not be plugged into a live power line.

If the meter does not show any reading when a strong signal can be heard in the phones at the output jack, try replacing V-53.

If meter does not show any reading and no signal can be heard in phones at output jack with instrument on, plug input signal into AMPLIFIER INPUT jack. Then, if there is still no reading with an input signal of the order of one volt, check that LEVEL control is in maximum clockwise position. Try replacing all the tubes.

3.3 VACUUM-TUBE DATA. The following table gives tube voltages measured between socket terminals and ground using a 20,000-ohm-per-volt meter. Voltages may vary as much as $\pm$ 20%.

A Battery Voltage = 1.5 volts **Total A Battery drain = 0.19 ampere**
B Battery Voltage = 90 volts **Total B Battery drain = 3.7 milliamperes**

Symbol	Type	Socket Pin Number				Function
		1	2	3	7	
V-51	1U4	0.2	20	38	1 and 7 1.2	Amplifier
V-52	1U4	0.2	10	31	1 and 7 1.2	Amplifier
V-53	1T4		49	49	1 and 7 1.45	Voltmeter
V-54	1U4		45	90	1 and 7 1.45	Monitor

OTHER GENERAL RADIO INSTUMENTS USEFUL IN MEASUREMENT AND ANALYSIS OF SOUND AND VIBRATION

TYPE 1555-A SOUND-SURVEY METER. An inexpensive, pocket-sized instrument for use in general survey measurements. Consists of a nondirectional microphone, adjustable calibrated attenuator, amplifier with A, B, and C weighting networks, and an easy-to-read meter. Measures sound levels from 40 to 136 db (re 0.0002μbar).

TYPE 1551-B SOUND-LEVEL METER. The accepted instrument for the measurement of sound-pressure level. Meets all applicable standards of the American Standards Association. Output available at jack for accessory analyzer, recorders, special microphones, etc. Sound level range from 24 to 150 db (re 0.0002μbar).

TYPE 1556-A IMPACT NOISE ANALYZER. Measures peak amplitude and duration (decay time) of impact sounds. Also evaluates variation among peak values in repetitive impacts.

TYPE 1554-A SOUND AND VIBRATION ANALYZER. Used with Sound-Level Meter or Vibration Meter, measures amplitude and frequency of various frequency components in sounds or vibrations. Frequency range from 2.5 to 25,000 cps, with choice of narrow, one-third-octave, or all-pass band widths. Battery-powered and portable.

TYPE 761-A VIBRATION METER. Portable instrument directly indicates rms values of acceleration, velocity, and displacement. Includes inertia-operated crystal pickup.

TYPE 1521-A GRAPHIC LEVEL RECORDER. Plots linearly in db the rms level of ac voltages from 20 cps to 200 kc. Produces permanent ink records of response of electrical or electroacoustic devices as a function of either frequency or time. Useful in reverberation-time and decay-rate measurements, speaker and microphone response measurements, etc. Special link assemblies and chart papers available to adapt recorders for use with Type 1554-A and 760-B Analyzers.

TYPE 1390-B RANDOM-NOISE GENERATOR. Generates wide-band noise suitable for many types of electrical and mechanical tests. Three ranges provide uniform spectrum levels from 20 cps to either 20 kc (uniform within $\pm$1db), 500 kc (uniform within $\pm$3db), or 5 Mc (uniform within $\pm$8db). Meter indicates rms output voltage. Output level is adjustable, and a step attenuator is provided.

ALSO:

Type 1552-B SOUND-LEVEL CALIBRATOR
Type 1551-P1 CONDENSER MICROPHONE
Type 759-P25 DYNAMIC MICROPHONE ASSEMBLY

and accessories. See latest General Radio Catalog.

Parts List

PART NO. (NOTE A)	RESISTORS (All resistances are in ohms unless otherwise specified)			
R1	35 k	± 1%	1/4 w	REF-65
R2	35 k	± 1%	1/4 w	REF-65
R3	30 k	± 1%	1/4 w	REF-65
R4	7.9 k	± 1%	1/4 w	REF-65
R5	5.1 k	± 5%	1/2 w	REC-20BF
R6	25.3 k	± 1%	1/4 w	REF-65
R7	90.8 k	± 1%	1/4 w	REF-65
R8	10.7 k	± 1%	1/4 w	REF-65
R9	135 k	± 1%	1/4 w	REF-65
R10	20 k	± 1%	1/4 w	REF-65
R11	6.2 k	+ 1%	1/2 w	REF-70
R12	5.9 k	± 1%	1/2 w	REF-70
R13	27 k	± 1%	1/4 w	REF-65
R14	70 k	± 1%	1/4 w	REF-65
R15	15 k	± 1%	1/4 w	REF-65
R16	22	± 5%	1/2 w	REC-20BF
R17	100	± 5%	1/2 w	REC-20BF
R18	820	± 5%	1/2 w	REC-20BF
R19	1.00	± 5%	1/2 w	REC-20BF
R20	470	± 5%	1/2 w	REC-20BF
R21	160 k	± 5%	1/2 w	REC-20BF
R22	27 k	± 1%	1/4 w	REF-65
R23	75 k	± 1%	1/4 w	REF-65
R24	15 k	± 1%	1/4 w	REF-65
R25	22	± 5%	1/2 w	REC-20BF
R26	100	± 5%	1/2 w	REC-20BF
R27	910	± 5%	1/2 w	REC-20BF
R28	2.4 k	± 5%	1/2 w	REC-20BF
R29	470	± 5%	1/2 w	REC-20BF
R30	390 k	±10%	1/2 w	REC-20BF
R51	340 k	± 1%	1/2 w	REF-70
R52	108 k	± 1%	1/2 w	REF-70
R53	34.1 k	± 1%	1/2 w	REF-70
R54	10.8 k	± 1%	1/2 w	REF-70
R55	3.41 k	± 1%	1/2 w	REF-70
R56	1.58 k	± 1%	1/2 w	REF-70
R57	10 M	± 5%	1/2 w	REC-20BF
R58	5.1	±10%	1/2 w	REW-3C
R59	560 k	± 5%	1/2 w	REC-20BF
R60	300 k	± 5%	1/2 w	REC-20BF
R61	39 k	±10%	1/2 w	REC-20BF
R62	1 M	±20%		POSC-18
R63	5.1	±10%	1/2 w	REW-3C
R64	820 k	± 5%	1/2 w	REC-20BF
R65	300 k	± 5%	1/2 w	REC-20BF
R66	240 k	± 5%	1/2 w	REC-20BF
R67	5.1 M	± 5%	1/2 w	REC-20BF
R68	10 M	± 5%	1/2 w	REC-20BF
R69	27 k	± 5%	1/2 w	REC-20BF
R70	39 k	± 5%	1/2 w	REC-20BF
R71	9 k	± 1%	1/4 w	REF-65
R72	900 k	± 1%	1/4 w	REF-65
R73	5.1	±10%	1/2 w	REW-3C

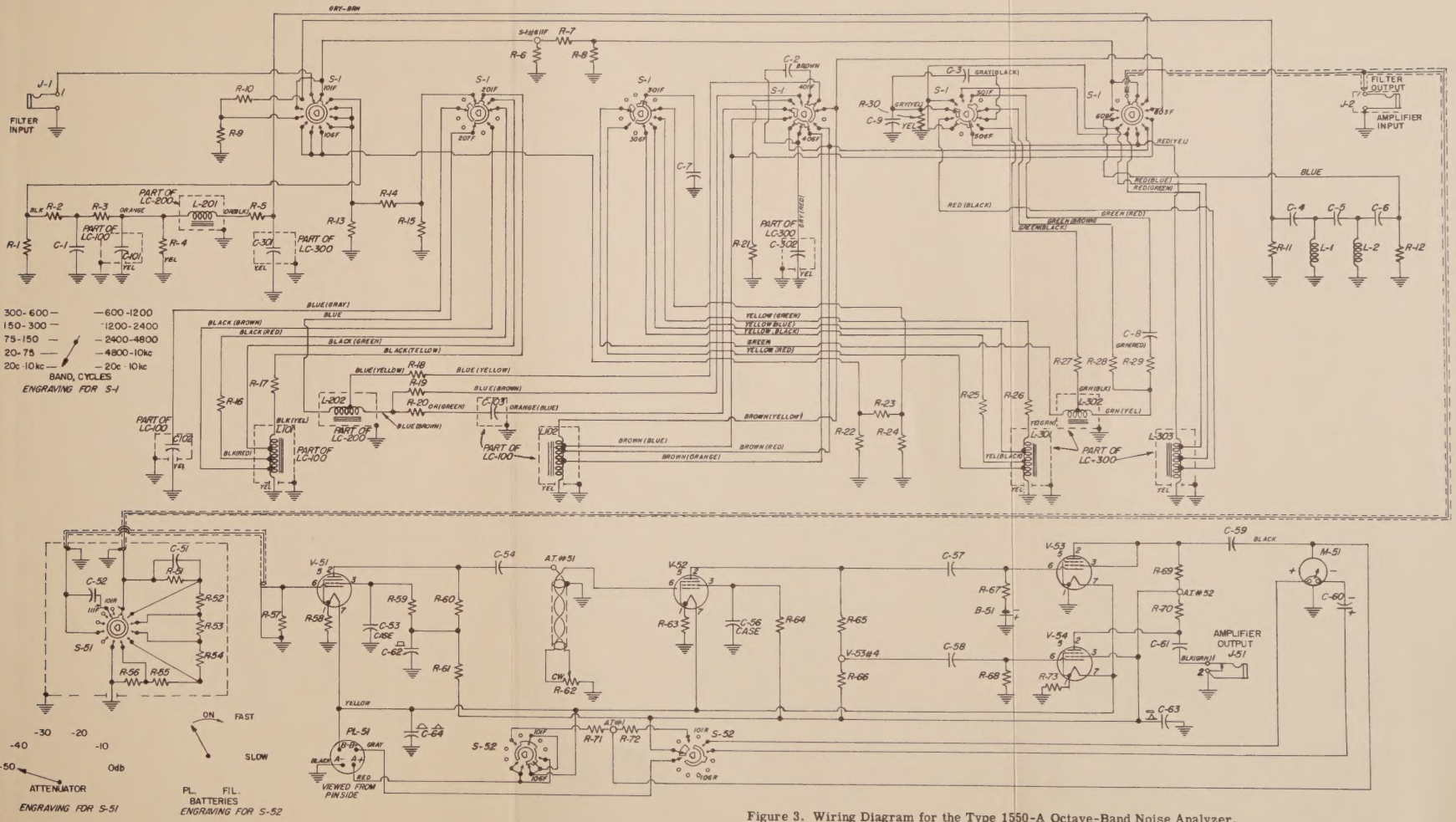
CAPACITORS (All capacitances are in μf unless otherwise specified.)			
C1	0.11	± 2% (two in //)	ZCOP-8-3
C2	0.0375	± 2%	COM-50C
C3	0.005	± 2%	COM-45C
C4	0.0027	± 2%	COM-45C
C5	0.00135	± 2%	COM-45C
C6	0.0027	± 2%	COM-45C
C7	0.05	± 2%	ZCOP-8-1
C8	0.0207	± 2%	COM-50C
C9	0.0157	± 2%	COM-50C
C51	10μμf	±10%	COM-20B
C52	0.005	±10%	COM-35B
C53	0.22	±10%	COW-17
C54	0.1	±10%	COW-16
C56	0.22	±10%	COW-17
C57	0.01	±10%	COW-16
C58	0.01	±10%	COW-16
C59	1.0	±10%	COW-17
C60	200	10 dcwv	COE-6
C61	1.0	±10%	COW-17
C62	40	150 dcwv	COEB-14
C63	80	150 dcwv	
C64	4400	5 dcwv	COEB-26

MISCELLANEOUS		
	BATTERY, 90 1-1/2 v	6TA60
B51	BATTERY, 1-1/2 v	2BAC-4
J1	JACK	CDSJ-820
J2	JACK	CDSJ-820
J51	JACK	CDSJ-1281
L1	INDUCTOR, 208mh ±2%	ZCHA-43
L2	INDUCTOR, 208mh ±2%	ZCHA-43
LC100	FILTER UNIT	1550-200
LC200	FILTER UNIT	1550-201
LC300	FILTER UNIT	1550-202
M51	METER, 150 μa	488-301A
PL51	BATTERY ADAPTER	CDMP-1344
S1	SWITCH	SWRW-53
S51	SWITCH	SWRW-51
S52	SWITCH	SWRW-52

NOTES:

(A) Type designations for resistors and capacitors are as follows:

COE-Capacitor, electrolytic
COEB-Capacitor, electrolytic block
COM-Capacitor, mica
COP-Capacitor, plastic
COW-Capacitor, wax
POSC-Potentiometer, composition
REC-Resistor, composition
REF-Resistor, film
REW-Resistor, wire-wound


FILTER INPUT
J-1
S-1
R-1
R-2
R-3
R-4
R-5
R-6
R-7
R-8
R-9
R-10
R-11
R-12
R-13
R-14
R-15
R-16
R-17
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R-19
R-20
R-21
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R-25
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R-28
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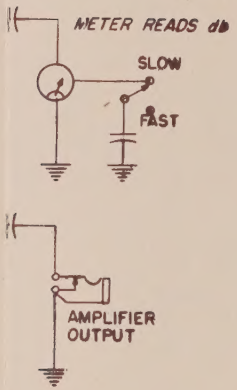
R-30
C-1
C-2
C-3
C-4
C-5
C-6
C-7
C-8
C-9
C-51
C-52
C-53
C-54
C-56
C-57
C-58
C-59
C-60
C-61
C-62
C-63
C-64
L-1
L-2
L-101
L-102
L-103
L-201
L-202
L-301
L-302
L-303
PART OF LC-100
PART OF LC-200
PART OF LC-300
FILTER OUTPUT
J-2
AMPLIFIER INPUT
300-600
150-300
75-150
20-75
20c-10kc
600-1200
1200-2400
2400-4800
4800-10kc
20c-10kc
BAND, CYCLES
ENGRAVING FOR S-1
BLUE(GRAY)
BLUE
BLACK(BROWN)
BLACK(RED)
BLACK(GREEN)
BLACK(YELLOW)
BLUE(YELLOW)
BLUE(YELLOW)
BLUE(BROWN)
BLUE(BROWN)
ORANGE(BLUE)
BLK(YEL)
BLK(RED)
YELLOW(GREEN)
YELLOW(BLUE)
YELLOW(BLACK)
GREEN
YELLOW(RED)
BROWN(YELLOW)
BROWN(BLUE)
BROWN(RED)
BROWN(ORANGE)
RED(BLACK)
GREEN(RED)
GREEN(BROWN)
GREEN(BLACK)
RED(BLUE)
RED(GREEN)
RED(YEL)
BLUE
GRN(RED)
GRN(BLK)
GRN(YEL)
YEL(BLACK)
YEL
BLACK
GRAY(BLACK)
GRAY(RED)
GRY(YEL)
ORANGE
BLK
ORA(BLK)
YEL
YEL
YEL


METER READS dB
SLOW
FAST
AMPLIFIER
OUTPUT

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